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Evaluating the Accessibility of U. S. Airports: Results from the American Travel Survey

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1. INTRODUCTION

The 1995 American Travel Survey (ATS), conducted for the Bureau of Transportation Statistics by the Bureau of the Census, is the most comprehensive survey of long-distance travel in the United States since 1977 (Bureau of Transportation Statistics, 1999). Trip and traveler information for all long-distance travel (i.e., 100 miles or more one way) was collected for approximately 80,000 U. S. households during the 12-month period of 1995. The survey collected detailed information on trip purpose, modes of transportation used, origin and destination, lodging type, and trip duration, as well as, demographic characteristics of travelers and their households. The ATS data provide policy makers the most accurate and comprehensive information ever available regarding long distance travel at both national and regional (state and metropolitan area) levels.

The major purpose of this study was to utilize the abundant information collected in the ATS to evaluate the accessibility of U. S. airports and to gain a better understanding of the pattern of air passenger traffic among competing airports. In this paper, no effort was made to use modeling approaches to study airport choices. Instead, the objective here is to utilize air travel data collected by the ATS to identify regional, socioeconomic, and demographic factors which influence airport accessibility. First, the ATS person demographic file is utilized to compare the demographic characteristics of persons who took at least one trip by air in 1995 with those persons who traveled exclusively by other modes. Characteristics of travelers are also compared to non-travelers (i.e. persons who took no long distance trips in 1995). This information is used to determine what demographic factors may influence whether travelers choose to (or are able to) travel by commercial air. Secondly, we use the more detailed ATS person-trip file in conjunction with data from the demographic file to determine which factors may affect the airport accessibility. Specifically, the following issues are addressed:

1. the geographic area served by selected airports;

2. variability of mode utilized by travelers to access selected airports;
3. the affect of trip purpose, duration and income on access mode;
4. rail access; and
5. egress mode chosen by travelers to selected metropolitan areas.

2. DEMOGRAPHIC CHARACTERISTICS OF AIR TRAVELERS

Based on the ATS demographic data, it was found that over 62% of the U. S. population took at least one long-distance trip during the 12-month period in 1995. Among these travelers, over 34% took at least one trip by commercial air. These air travelers made a total of over 183 million person trips on the commercial airplanes accounting for approximately 18% of the total person trips by U. S. residents during 1995.[1] Although air travelers account for only 21 % of the total 1995 U.S. population, they produced about 463 million person trips by all modes in 1995. This equals approximately 44% of the more than 1 billion person trips generated by U. S. residents during 1995, thus the impact of these travelers on the travel industry and U. S. economy should not be overlooked.

While 66% of white population traveled long-distance at least once during 1995, only about 40% of black population made one or more long-distance trips in the same year (Figure 1). Commercial air was used, at least once, for approximately 35% of the white travelers as compared to 26% of the black travelers. Approximately 66% of the Asian/Pacific Islanders who lived in the United States traveled long-distance in 1995, and over 51% of them took at least one long-distance air trip during the year. As expected, air is the main mode of transportation for long distance travel by residents of Hawaii due to the geography of the state (i.e., multiple islands) and the distance to the U.S. mainland.

For U. S. residents (15 years or older) approximately 71% of air travelers have education beyond the high school level (Figure 2). In contrast, only 29% of non-travelers have education beyond the high school level. Education level for the non-air traveler group is about equally divided between those educated beyond the high school level (48%) and those who never attended college (52%).

In this paper, household income levels were grouped into four categories:

1. the low-income group includes people from households with total annual income of less than $25,000;
2. the middle-income group consists of people from households with total annual income between $25,000 and $49,999;

[1] For the purpose of this paper, an air traveler is defined as a person who took at least one long-distance trip by commercial air in 1995. A non-air traveler is defined as a person who traveled long distance in 1995, but exclusively by other modes. A non-traveler is a person who took no long distance trips in 1995.

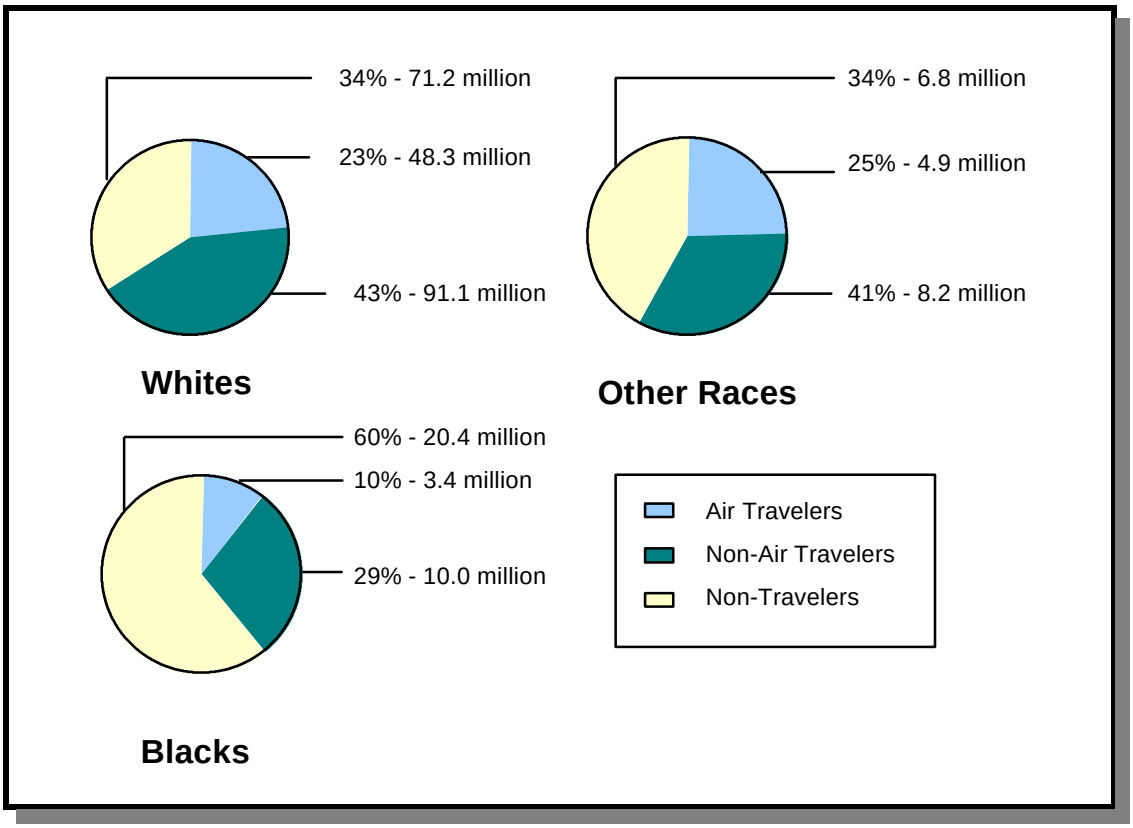

Figure 1. Travel status of U.S. residents by race (1995 American Travel Survey, U.S. Bureau of Transportation Statistics).

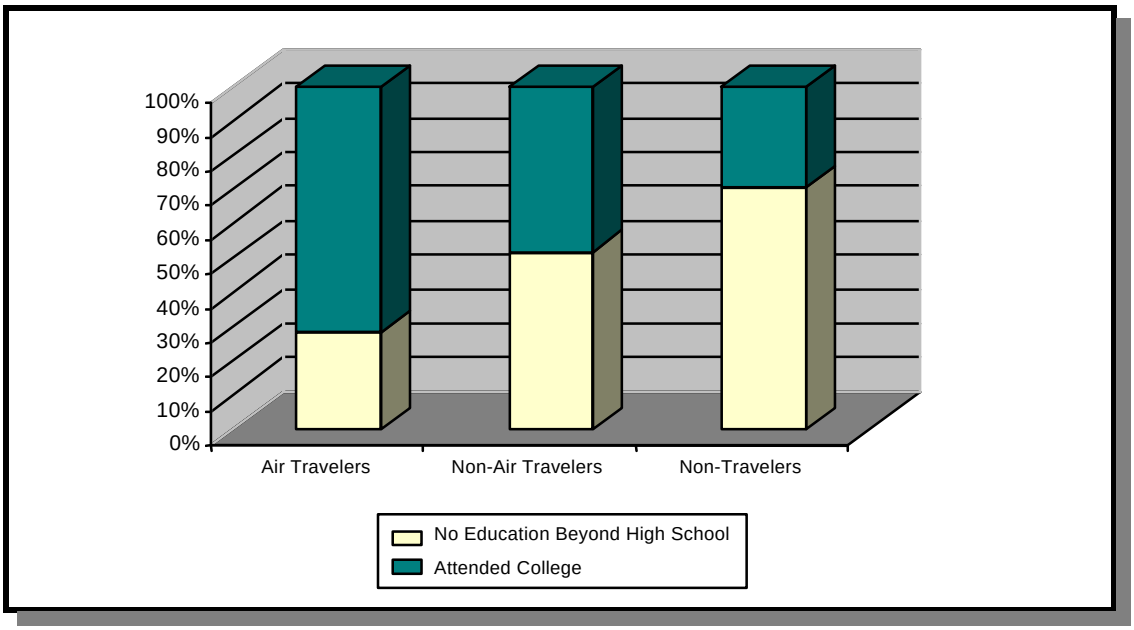

Figure 2. Travel status of U.S. residents by education level (1995 American Travel Survey, U.S. Bureau of Transportation Statistics).

3. upper-middle income group consists of people from households with total annual income between $50,000 and $74,999; and
4. high-income group includes people from households with total annual income of $75,000 or more.

Only 10 % of people from households in the lower income group took a trip by air in 1995 as compared with 35 % of people from upper income households (Figure 3). Eighteen percent of people in the middle income group traveled by air; 28 % of people in the upper middle income group were air travelers (Figure 3). The difference between the income groups is even more striking if one looks at non-travelers. More than half (57 %) of people in lower income households took no long distance trips in 1995 whereas only 12% of people in upper income households were non-travelers. These data suggest that the accessibility of the air transportation system may be significantly influenced by the demographic and socioeconomic status of persons and their households.

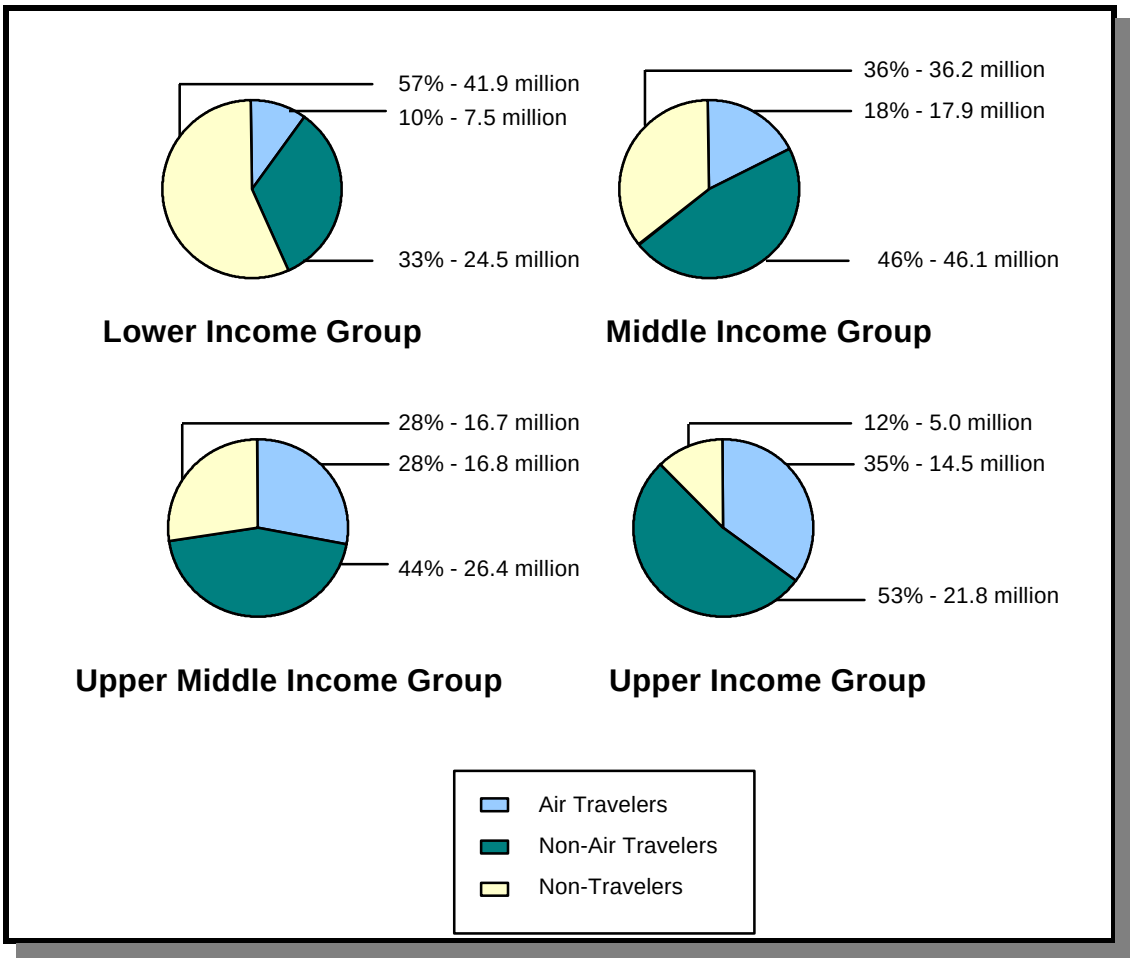

Figure 3. Travel status of U.S. residents by income (1995 American Travel Survey, U.S. Bureau of Transportation Statistics).

3. AIRPORT ACCESSIBILITY

3.1 DATA SOURCES

The ATS trip data utilized in this study are mainly related to travel by commercial airline These data include: location of originating airport, destination, trip purpose, duration, travel party size, access and egress modes of transportation, as well as demographic characteristics such as household income and race of the travelers.

To simplify the data set used for this paper, trip records which specified commercial air as their out-bound main mode of transportation were extracted from the ATS trip micro data file. Trip records with imputed[2] originating airports (i.e., the out-bound airport was not reported) were excluded from the initial data set. This reduced the number of records by approximately 6%. A small percentage (1 - 2%) of trip records which included a stop (other than for refuel or food) prior to departure from the originating airport were also eliminated from the study data set. For example, if a traveler drove to visit a relative in city A and then got on a plane from airport B to go to city C, the trip was excluded from the data set. This reduced the confusion in defining the 'originating' airport for multi-mode (i.e., intermodal) trips. This does not, however, eliminate any trips which began as a air travel but followed with other modes to get to its final destination (e.g., cruise trips in particular). No adjustments of any kind were made in this analysis to account for the eliminated trips. This is by no means a complete study of the airport accessibility. The case study presented in this paper serves only as the first attempt to use the ATS data to examine air travel.

The air trip data file was merged with expansion factors and other selected variables from the ATS person trip file to form a 'person air-trip' database. This database was used to examine travel behavior and characteristics of air travelers. This 'person air-trip' file was also used in producing accessability statistics for a selected set of airports.

Since not all of the major U.S. airports could be examined in detail, representatives of three particular types of major airports were selected for more detailed analysis. The first group consists of airports which share particular geographic regions as common market areas (e.g., Kennedy, La Guardia, and Newark airports in the New York area; and National, Dulles, and Baltimore airports in the Washington/Baltimore area). These airports are referred to as being part of a "multi-airport-system." The second group of airports consists of airports that serve as major hubs in their respective regions (e.g., Hartsfield in Atlanta and Philadelphia International). The third group includes airports located in areas with major tourist attractions (e.g., Las Vegas, Nevada and Orlando, Florida). Once

[2] For air travel records that did not specify which airport (either by airport name or location) was used to begin the trip, Oak Ridge National Laboratory developed an algorithm to assign the most likely airport to the trip so that routing distance could be calculated. The method took into account both the functional class (hub size) of each possible choice of airport and the distance between the trip origin and each airport.

selected, the ATS data was used to determine the geographic areas served by these airports and to identify non-price factors that might affect passengers' choice of access modes and airports.

3.2 TOTAL ENPLANEMENT AND OUT-BOUND PASSENGER TRAFFIC FOR SELECTED AIRPORTS

Based on the total volume of passenger traffic at the airport and the criteria described in the previous section, a set of major airports along with some secondary airports located in the similar metropolitan regions were selected for study. Total enplanement statistics were obtained from the *Airport Activity Statistics of Certified Air Carriers, 12 months ending December 31, 1995*, published by the Office of Airline Information (OAI), Bureau of Transportation Statistics (see Table 1).

Based on data contained in 'person air-trip' file, total volumes of air passenger trips originating from the selected airports were generated. These estimates along with their associated standard errors (estimated at 95% level by the Jackknife simulation) for some of the selected airports are provided in Table 1. Using the volume estimate and its standard error, a 95% confidence interval was constructed by adding or subtracting the value of standard error. For example, based on data in the study set, a 95% confidence interval for the estimated total volume of passengers originated from the Los Angeles International Airport would be in the range of 8.78 millions to 8.84 millions person trips.

Note that total enplanement from the OAI report (also presented in Table 1) includes passengers transferring from one flight to another at the airports. Estimates from the ATS air trip file accounts for only the out-bound passenger traffic at a given airport. It does not include air travelers passing through the airport on trips originating elsewhere, nor does it include return trips originating at the airport. That is, it includes only those air passengers who departed from the airport to begin their journey. This can be clearly seen by large discrepancies between the two columns shown in Table 1, especially for large air traffic hubs such as Los Angeles, O'Hare (Chicago), Dallas/Fort Worth,and Atlanta. Furthermore, the sample frame for ATS was based on the 1980 Current Population Survey (CPS) samples; travel by non-U.S. residents within the United States was not captured by the survey. The lack of foreign travel statistics would most likely affect passenger counts at international gateway airports. Furthermore, the enplanement statistics also include passenger traffics generated from trips that were excluded from this case study. Primarily, intermodal trips which began with non-air mode, trips with imputed airport locations, etc.

3.3 GEOGRAPHIC AREAS SERVED BY SELECTED AIRPORTS

Several factors may influence an airport's share of the market it serves, particularly in regions where multiple airports exist within similar access distances. These factors include convenience of ground transportation to and from the airport, destination cities served by the airport, number of airlines

Table 1. Number of Person Trips Originated from Airports in Selected Metropolitan Regions and Their Total Enplanements

Major Metropolitan Regions and Airports		No. of Originating Passengers[1] (thousands)	No. of Enplanements[2] (thousands)
Los Angeles, CA	Los Angeles (LAX)	8,805±30	21,072
	Orange Cty (SNA)	2,391±34	3,453
	Burbank (BUR)	1,562±22	2,436
New York, NY	Kennedy (JFK)	3,950±10	9,283
	La Guardia (LGA)	3,503±12	9,682
	Newark (EWR)	6,368±6	11,900
San Francisco, CA	San Francisco (SFO)	5,460±28	15,013
	San Jose (SJC)	2,361±26	4,267
	Oakland (OAK)	2,345±24	4,751
Chicago, IL	O'Hare (ORD)	7,532±8	29,886
	Midway (MDW)	1,576±8	4,170
Boston, MA	Logan (BOS)	4,878±4	10,508
	Providence (PVD)	557±2	965
	Manchester (MHT)	248±1	386
Washington/ Baltimore	Baltimore (BWI)	3,040±4	5,666
	National (DCA)	2,425±4	6,888
	Dulles (IAD)	1,854±4	4,574
Dallas/Fort Worth, TX	Dallas/Fort Worth (DFW)	4,325±12	25,964
	Love Field (DAL)	2,622±14	3,412
Seattle, WA	Seattle-Tacoma (SEA)	4,403±4	10,731
Phoenix, AZ	Phoenix (PHX)	3,639±4	13,558
Denver, CO	Denver (DEN)	3,611±4	14,328
Atlanta, GA	Atlanta (ATL)	3,588±4	27,557
Minneapolis/St. Paul, MN	Minneapolis/St. Paul (MSP)	3,151±4	11,836

Source of data: [1] 1995 American Travel Survey, Bureau of Transportation Statistics.
[2] *Airport Activity Statistics of Certified Air Carriers, 12 months ending December 31, 1995*, Office of Airline Information, Bureau of Transportation Statistics.

providing services for the same route, airline schedules, flight frequencies, and the ticket pricing structures that airlines provide for each airport. A number of recent studies have focused on modeling airport choice in areas served by multiple airports (Harvey, 1987, Cohas, 1995; and de Neufville, 1995). They demonstrated that major factors influencing a passenger's choice of airport include travel time to the airport, air fares, and airline schedule or frequency.

The ATS data suggest that the extent of geographic areas served by a particular airport is highly variable. It depends upon where the airport is located, what functional class (size of facility, hub/non-hub, etc.) the airport is in, and what services (airline choices and frequencies) are available from the airport. Airports in large states (e.g., California) tend to serve those who lives within the same state. Major airports with greater availability of service, in general, serve larger areas. For example, 75% of Los Angeles International Airport (LAX) out-bound passenger trips was generated by those who lives within the Los Angeles-Long Beach metropolitan area. Another 18% person trips was generated by people living in Ventura or Orange County. Less than .5 percent of the total passenger trips originating at LAX resulted from travelers residing outside of California. More regional-oriented airports (e.g., Burbank (BUR) and Orange County (SNA)) typically served only those residing in the nearby metropolitan areas. Geographic areas served by airports in the smaller New England states generally cross state boundaries. Major International airports such as New York Kennedy Airport (JFK) and Logan International in Boston (BOS) attracted a large share of out-bound passenger trips from other metropolitan area, as well as from other states. Less than 51% of the out-bound passenger trips for JFK were generated by people who lived in the New York PMSA. Still if one look at the distribution of travelers using the three New York area airports (Figure 4), Newark primarily serves residents of northern New Jersey whereas La Guardia and Kennedy serves primarily residents of Long Island, southern New York, and nearby Connecticut. In the DC area (Figure 5), Baltimore-Washington (BWI) typically serves residents of the Baltimore area and some between DC and Baltimore. Dulles and National airports serve resident of Virginia, DC, and western Maryland.

As the largest airport in the southern U.S., the geographic areas served by Atlanta International airport (ATL) is larger than that served in other regions (Figure 6). About 10% of passenger trips originated from ATL came from persons who lived in neighboring states, Alabama and Tennessee in particular.

3.4 AIRPORT ACCESS MODE

Based on data in the "person-air trip" database, most out-bound air passengers drove to the airport and parked their vehicles at the airports (54%). Approximately 31% of air travelers were dropped off at the airport by private vehicles. Taxi and limo or shuttle bus provided transportation to the airport for approximately 13 % of the outbound trips. Public transportation such as bus and rapid transit usage accounted for a very small share in airport access. This indicated that public transportation, in general, is not a convenience mode of choice for accessing the airports. The hassle of hauling luggage up and down the bus or transit rail, the trouble of transferring between transit

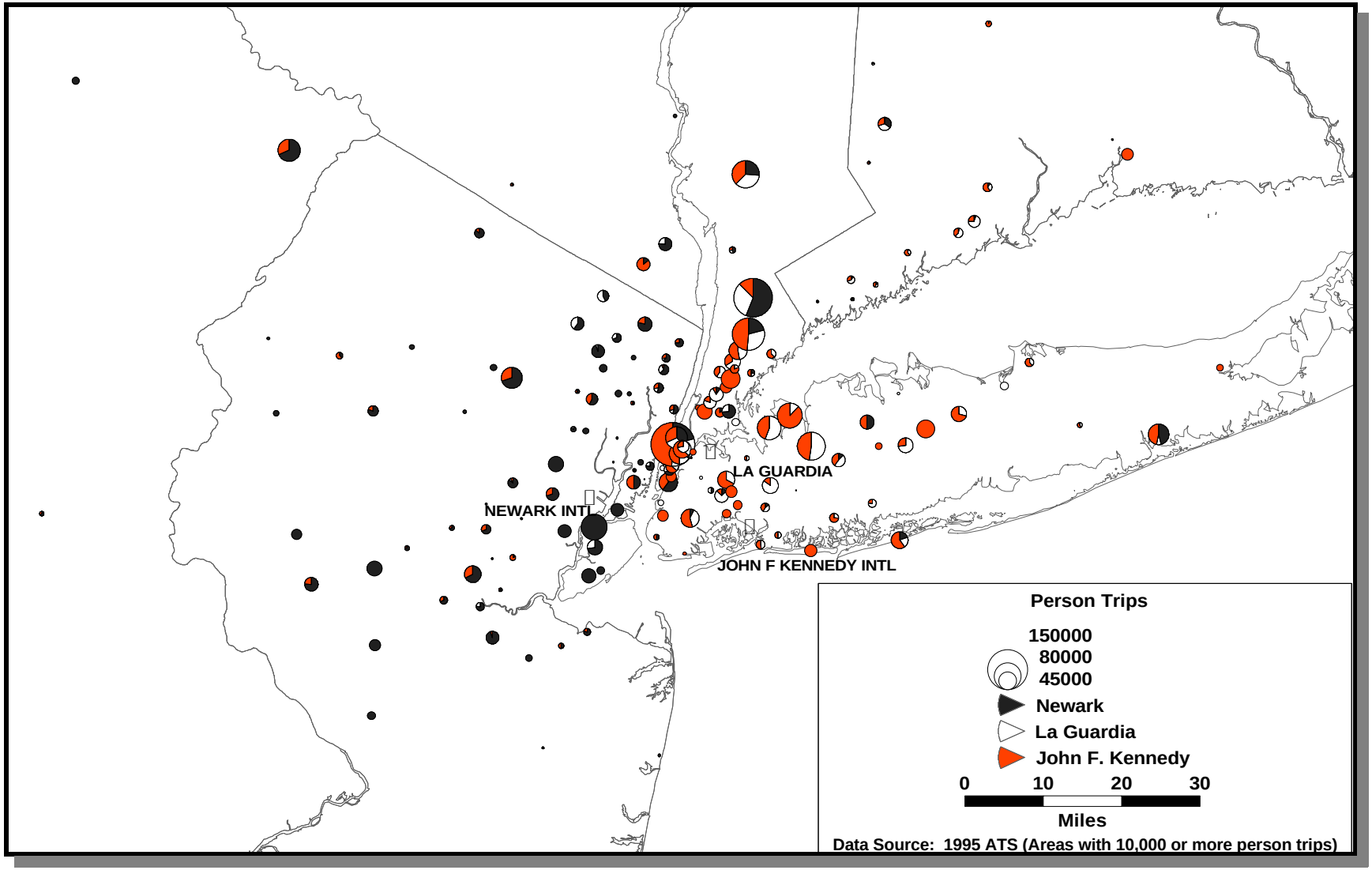

Figure 4. Major geographic areas served by Newark (EWR), La Guardia (LGA), and Kennedy (JFK) airports.

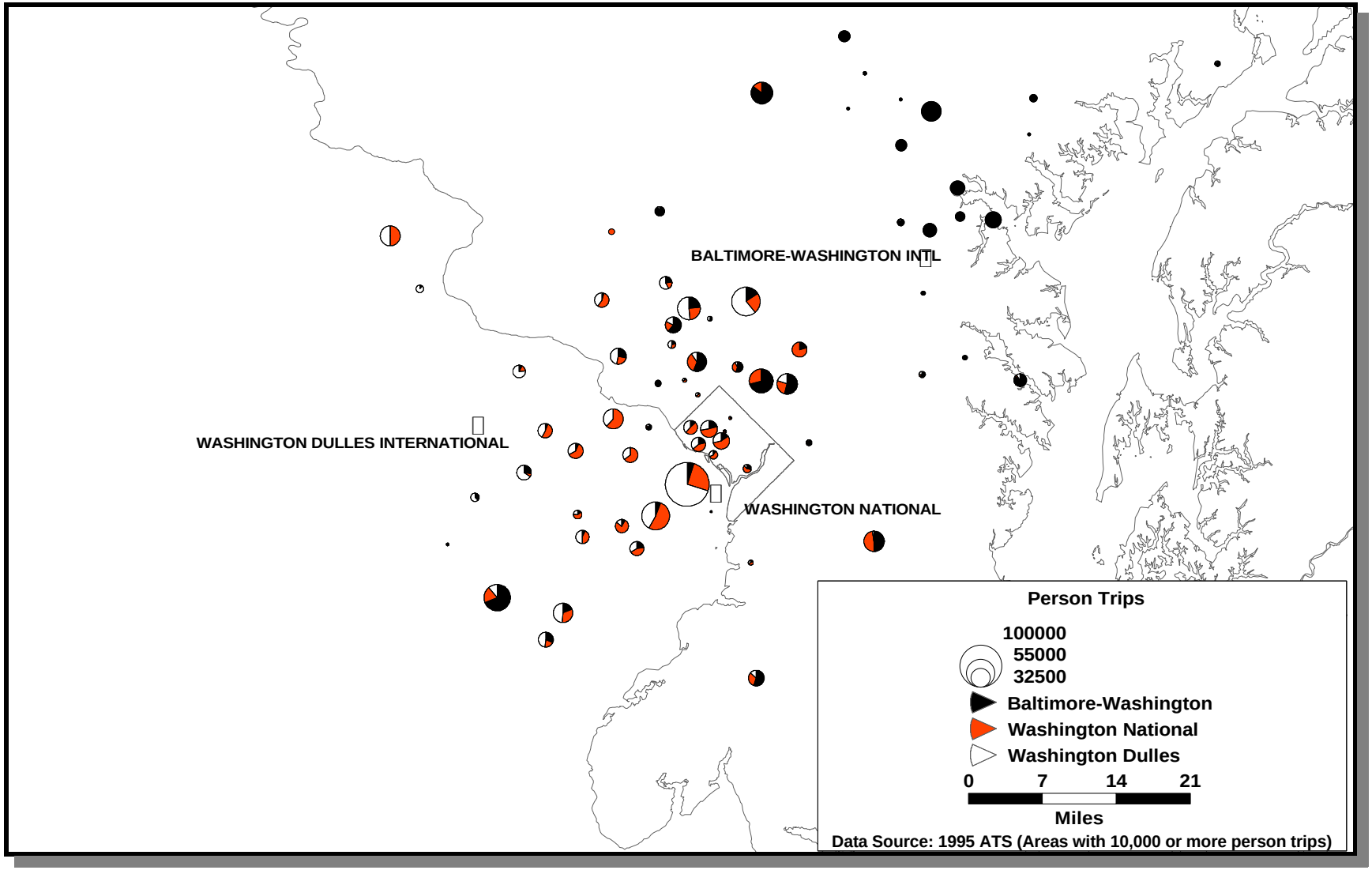

Figure 5. Major geographic areas served by Baltimore-Washington (BWI), Washington National (DCA), and Washington Dulles (IAD) airports.

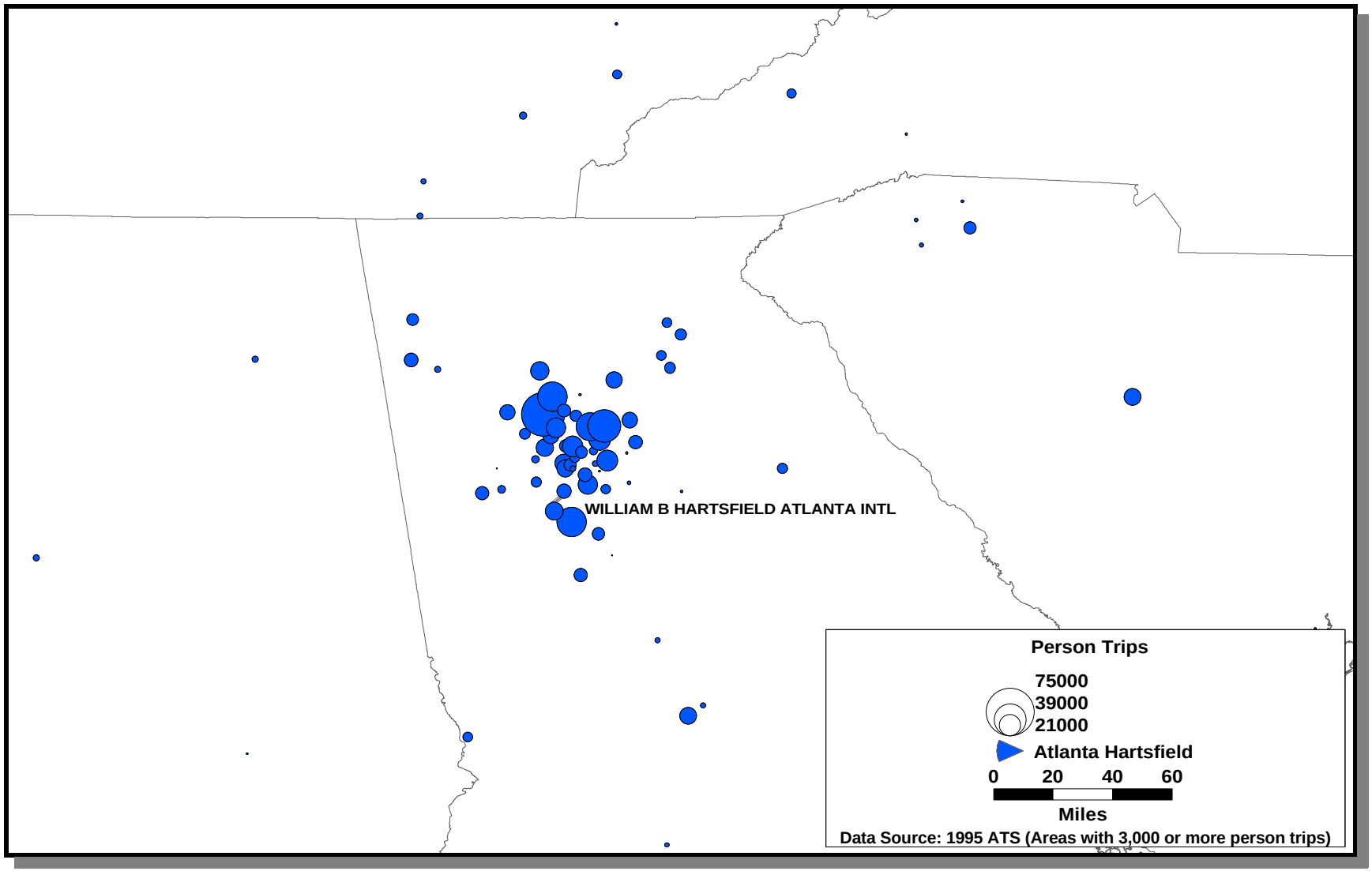

Figure 6. Major geographic areas served by Atlanta Hartfield International Airport.

lines with luggage, and, mostly, the uncertainty about schedule of the transit systems might have been the reasons why air passengers are reluctant to use these modes. (Access by rail at specific airports is discussed in more detail below). Table 2 summarized some access mode statistics based on data from this case study.

Table 2. Access mode statistics from the study set (i.e., out-bound passenger air trips)

Access Mode	# of person trips (thousands)	Share (%)	median travel distance to airport (mile)	median round trip length (mile)
own vehicle (parked at airport)	94,503	54.1	25	1,823
dropped-off by others	54,816	31.4	17	2,445
motorcycle/ moped	50	0.0	22	1,922
taxi	10,582	6.1	10	2,407
limo/shuttle bus	12,112	6.9	34	2,627
public bus	1,164	0.7	49	2,332
subway/rail	1,090	0.6	12	1,608
walked	56	0.0	S	S
other	160	0.1	S	S

S = unreliable data due to high sample variations

Access mode varies by trip purpose, income and the duration of the trip. In general, business travelers were more likely to drive and park at the airport (61 %) than leisure travelers (51%) and travelers visiting friends and relatives (46 %)[3]. Figure 7 shows that leisure travelers and travelers visiting friends and relatives were more likely (34% and 41% respectively) to be dropped off at the airport; only 29 % of business travelers were dropped off at the airport. The higher percentage of business travelers leaving their car at the airport is probably due to the fact that it is typically most convenient and most business travelers will be reimbursed for their costs.

[3]Business trips are defined as trips where the purpose of the trip is given as business, combined business with pleasure, or convention, conference or seminar. Leisure trips include trips where the purpose of the trip is given as rest or relaxation, sightseeing, outdoor recreation, entertainment or shopping. Pleasure trips include leisure trips as well as trips to visit friends or relatives. Personal business trips are defined as any trip where the purpose of the trip is given as school-related activity or personal or family business including weddings and funerals. Personal business trips are defined as any trip where the purpose of the trip is given as school-related activity or personal or family business including weddings and funerals

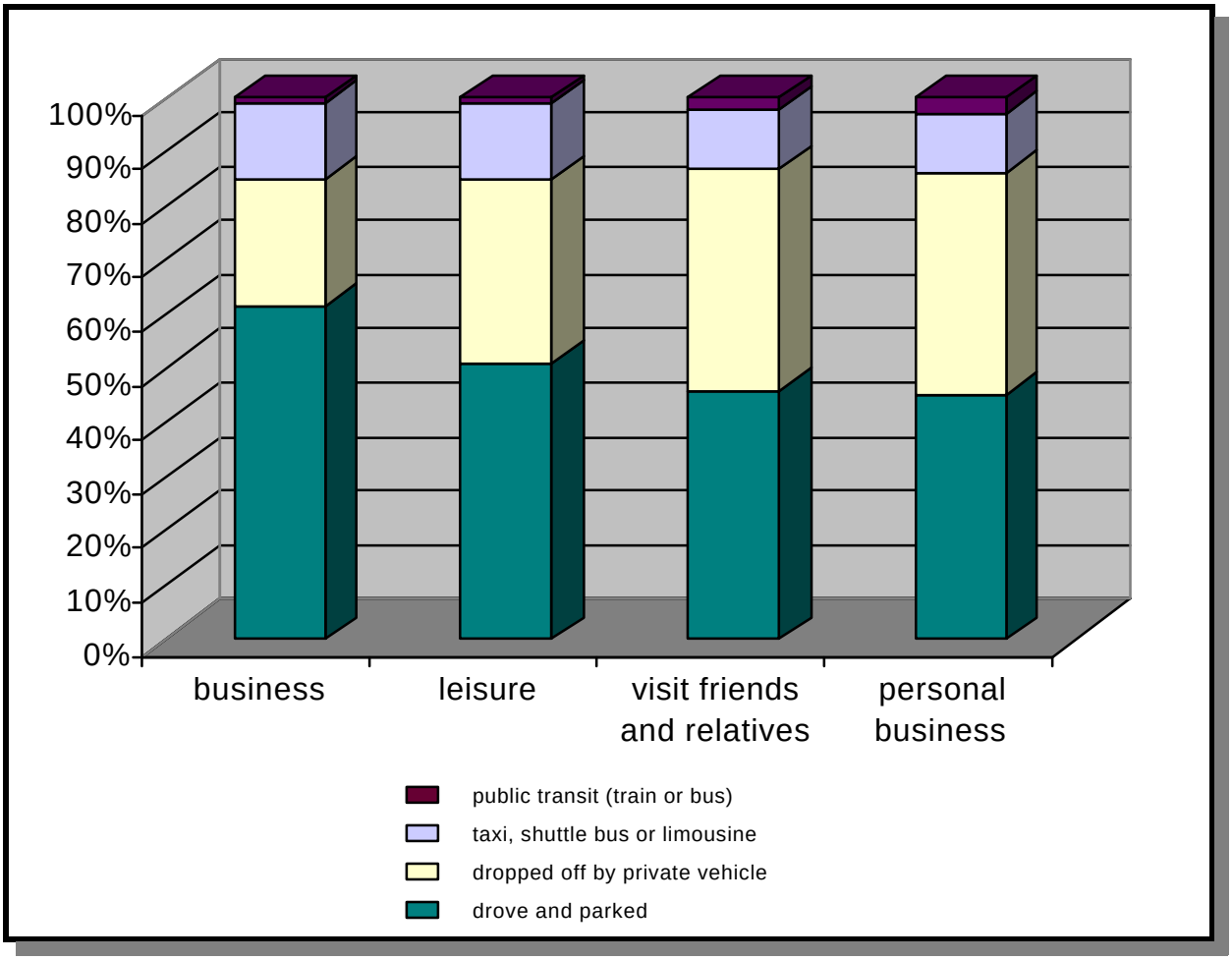

Figure 7. Trip purpose by access mode to the airport (percent of person trips)
(1995 American Travel Survey, U.S. Bureau of Transportation Statistics)

As expected the access mode varies with the duration of the trip. As presented in Figure 8, the percent of travelers parking at the airport declines dramatically and the percent of travelers dropped off at the airport increases with the length of the trip. For example, 62 - 72 % of travelers spending 0 - 2 nights away from home drove and parked at the airport whereas only 39 % of travelers spending 7 to 30 nights away from home drove parked at the airport.

Access mode also varies somewhat by household income. Although travelers in all four income groups were most likely to drive and park at the airport, 43 % of travelers from lower income households elected to drive and park at the airport whereas more than half of the air travelers from the other three income groups parked at the airport. In general, travelers from upper income households were least likely to be dropped off (only 25 %), most likely to park at the airport (56 %), and slightly more likely to take a taxi or limo to the airport (18 %).

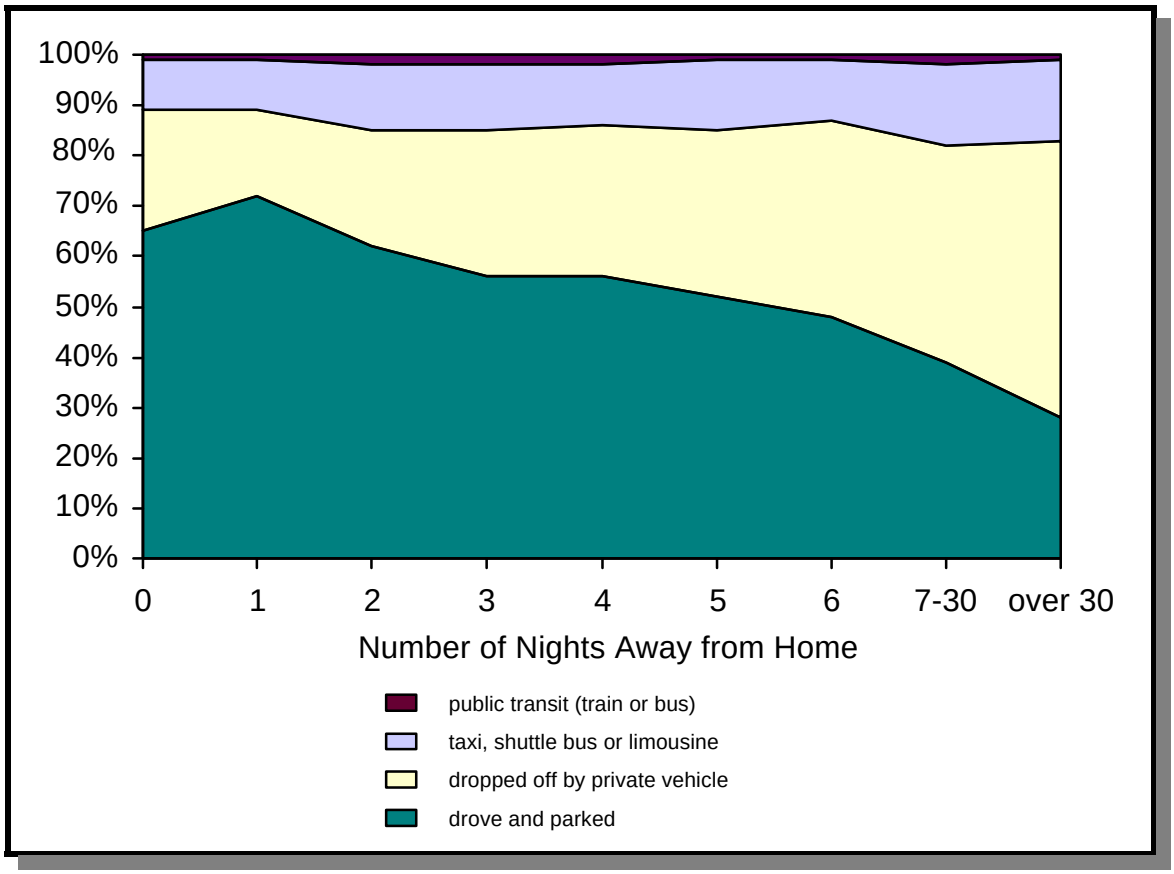

Figure 8. Trip duration by access mode to the airport (percent of person trips) (1995 American Travel Survey, U.S. Bureau of Transportation Statistics)

Regional differences are also apparent in the access mode and purpose of trips departing from specific airports. Travelers originating from the three airports (National, Dulles, and BWI) serving the Washington airport are typically traveling for business. In contrast, travelers from LAX (Los Angeles) and SFO (San Francisco) along with JFK in New York are typically taking pleasure trips. All three of these airports serve as major international gateways. In fact only 17 % of person trips originating in San Francisco are business trips; however, if only domestic trips are considered, the percentage of business person trips from SFO increases to 56 %. Of the three New York airports, JFK serves a greater percentage of pleasure travelers (60 % of person trips) vs. business travelers (25 % of person trips), whereas La Guardia and Newark, which serve primarily domestic customers, are more evenly divided among business and pleasure in person trips. Midway of Chicago (a regional airport) serves primarily pleasure travelers whereas person trips from O'Hare approximately half are for pleasure and half are for business.

With the exception of travelers departing from the three airports serving the New York City area, most business travelers drove to the airport and parked. In fact, nearly three quarters of business travelers from Atlanta and Baltimore International Airports (BWI) drove to the airport. In contrast most travelers departing from the three New York airports took a taxi, limo or shuttle bus to the airport (Figure 9). These differences may reflect differences in the cost and convenience of parking at these airports as well as the difficulty of driving in the New York City area. For example ATL and

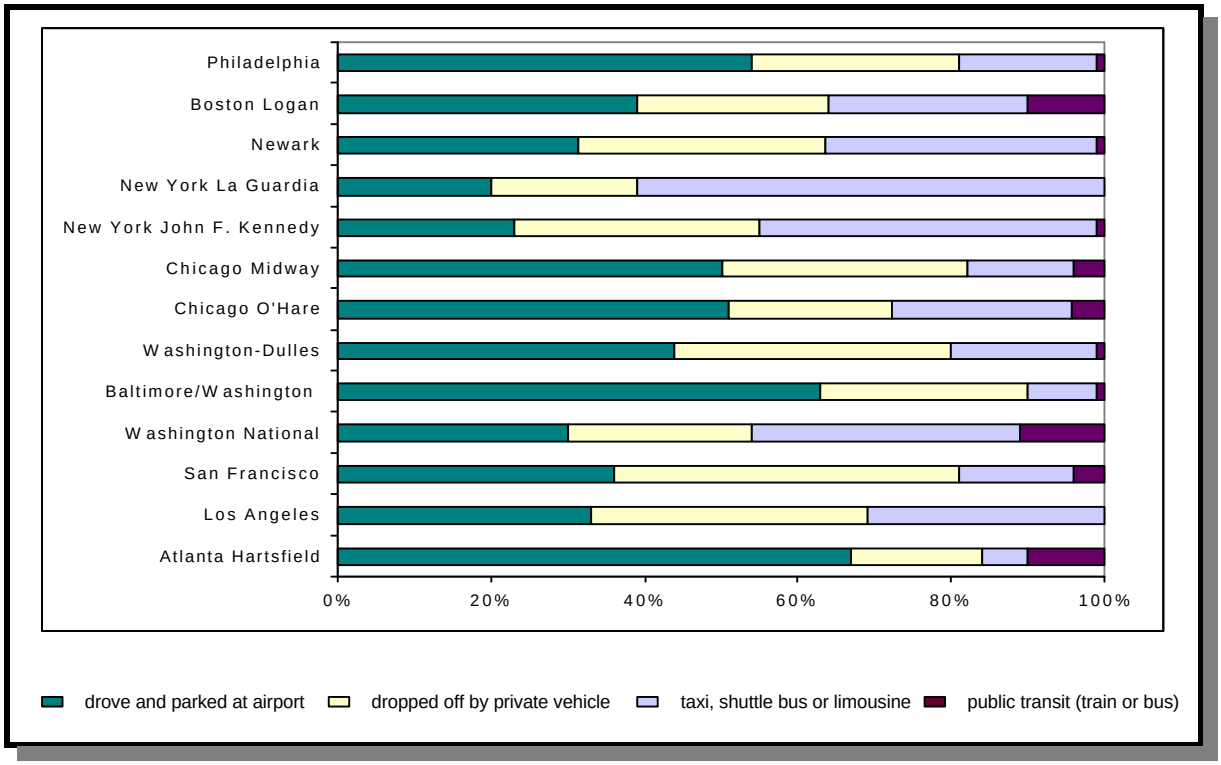

Figure 9. Access mode to selected airports (percent of person trips)
(1995 American Travel Survey, U.S. Bureau of Transportation Statistics)

BWI charge only $5/day and $7/day respectively for convenient parking. AtLGA parking is $24 for the first day and $10/day thereafter. At JFK, the long term parking is relatively inexpensive, but is 2 miles from the airport. Newark parking ranges from $8-12 per day.

3.5 ACCESS BY PUBLIC TRANSIT

Public transit is not the dominant access mode for any of the airports, but travelers originating from Atlanta, DCA (Washington), and Boston were more likely to use public transportation to get to the airport. Travelers from DCA have access to a convenient, well constructed system of public transportation. Both Atlanta and Boston have convenient access to rail as discussed below.

Table 3 shows the rail share of airport passengers originating from selected U. S. airports.[4] These estimates were generated from data on out-bound air passengers using subway/elevated rail or commuter-rail to reach to the airport. Although Boston does not have direct access from its rail system to Logan airport, Boston was included because of its' relatively high rail ridership share for air passengers (in comparison with other airports).[5]

The shares of rail ridership by airport passengers presented in Table 3 is consistent with the findings reported by Newmark (1999), in the sense that rail shares are generally low for all airports. In the study of 1998 rail share of airport access on a similar list of airports, Newmark pointed out that most airport rail connections serve less than six percent of air passengers might suggest that rail transit is an inconvenient option for air passengers. Newmark argued that "rail transit does not serve the airport access needs of most air passengers because the majority of air passengers comes from or return to areas not serviced by the rail system." As shown in Table 3, Washington National has the highest rail transit share of air passengers when compared to other airports. This may be related to it's higher percent of business travelers (about 49 %), proportion of short term travelers (who are less likely to require a rental car), as well as to the traffic conditions in the city.

The ATS data was used to provide an estimate of the median travel distance by persons accessing the airport by transit rail (Table 3). Basically these estimates look reasonable with the exception of Atlanta and Philadelphia, which appear to be high. Due to the lack of a rapid transit network capable for analytical use, the distances were estimated using the highway network thus the distances provided represent highway distances not the actual rail transit distance. In some instances (e.g., the Washington, DC Metro), the circuity for rapid transit may actually be higher than the highway distance because of the need to make transfers in certain central locations. In contrast, the MARTA train system in Atlanta may have a lower circuity than the highway system because of the location of the airport coupled with the design of the rail and highway systems in the city. The Atlanta airport is located at the southern tip of the MARTA system thus access by rail might be relatively "straight shot". In contrast access by highway to the Atlanta airport is typically by Interstate 285, an interstate loop encircling the city.

Another problem is related to the structure of the ATS survey questionnaire. Survey respondents are only permitted to select a single choice of access mode. Presumably, the survey respondents would report the last access mode used because that was the mode used to "get to the airport to begin the trip". No information is provided on the mode used to get to the rail transit station. Thus, the median distance to the airport calculated using the ATS data may be higher then the distance actually traveled by rail.

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[4] The airports shown Table 3 were selected based on Table 18 of the *1996 Transit Fact Book*.

[5] A direct rail-airport connection was defined as that passengers do not require a bus or van ride between the rail station and the airport terminal building. Airports with only internal non-transit rail circulation systems should not be categorized as having direct rail access.

Table 3. Airports with Direct Rail Transit Access[1]

City	Airport	Median Distance to Airport (highway mile)[2]	Out-bound Air Passengers by Rail Share (%)[3]	Rail Mode Shares from Newmark's 1998 Study[4]	Share of Business Person-trips among Out-bound Air Passengers (%)[1]	
					To All Destinations	To Domestic Destinations
Atlanta, GA	Atlanta	22	4.92	6.0	41.0	43.8
Chicago, IL	Midway	16	1.32	8.1	27.6	38.1
Chicago, IL	O'Hare	16	2.65	5.4	47.3	54.9
Cleveland, OH	Cleveland-Hopkins	S	S	3.0	S	S
Philadelphia, PA	Philadelphia	18	1.25	2.0	43.3	47.0
St. Louis, MO	Lambert-St. Louis	16	0.55	5.0	37.7	38.0
South Bend, IN	Michiana Regional	S	S	N/A	S	S
Washington, DC	Washington National	8	10.68	9.0	48.6	51.9
Boston, MA[5]	Logan	10	5.91	5.7	40.4	44.8

S = insufficient sample size in ATS data.
N/A = data not available.

[1] data sources: *1996 Transit Fact Book*, American Public Transit Association; 1995 American Travel Survey, Bureau of Transportation Statistics.
[2] from the 1995 ATS data, the estimated distance was calculated based on routing on the highway network between the origin zip code and the airport.
[3] based on 1995 ATS data for air trips originating from the given airports and used subway/elevated rail or commuter-rail as the access mode to the airport.
[4] Gregory Newmark, "Rail's Share of Airport Access: Examining the Data," Preprint CD-ROM, 78th Annual Transportation Research Board Meeting, 1999.
[5] Boston was not included in the *Transit Fact Book* due to the need of using shuttle bus connection to the airport. The estimated rail distance to Boston airport based on ATS data, therefore, includes distance for the shuttle bus ride.

4. EGRESS MODE AND PURPOSE OF TRIPS TO SELECTED CITIES

The person air trip file described previously was also used to examine the egress mode chosen by ATS air travelers. The egress modes selected by air travelers is shown in Figure 10. The majority of travelers were either picked up by private vehicle (36 %) or used a rental car (36 %) to get to their final destination. Approximately one quarter of the travelers used taxi or shuttle bus to reach their final destination. Only a small percentage (approximately 2 %) used public transportation (bus or rail) to travel to their final destination).

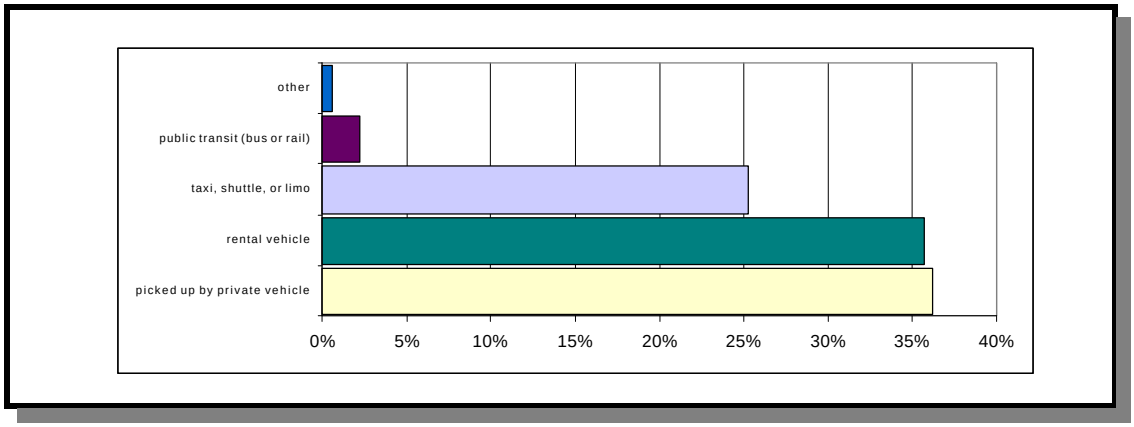

Figure 10. Egress mode used by air travelers (percent of person trips) (1995 American Travel Survey, U.S. Bureau of Transportation Statistics).

Unfortunately, detailed airport information was collected only for the originating airport, but was not collected for the destination airport. Thus, in cities where there are multiple large airports (e.g., New York, Chicago, Washington, DC) it was not possible to categorize the egress mode for a specific airport, but only for the MSA in general. Egress mode was examined for 14 U.S. cities: Las Vegas, Chicago, New York, DC, LA, San Francisco, Orlando, Dallas, Atlanta, Phoenix, Denver, Boston, Philadelphia, and St. Louis. The egress mode appears to vary significantly from city to city (Figure 11). For example, in Las Vegas and New York greater than 50 % of travelers took a taxi or airport limo/shuttle to travel to their final destination, whereas overall only 25 % used this mode. Public transit was not the dominant egress mode for any of the MSA's, but it was higher (ranging from 5% to 11%) in four cities (Chicago, DC, Boston, and Atlanta). All of these cities offer rail transportation to and from the airport. Public transportation was utilized as an egress mode for less than 5% of person-trips in the other ten cities.

Travelers to Orlando, were most likely to use rental cars; 53 % of travelers to Orlando used a rental car to travel to their final destination. More than half (54 %) of the person-trips to Orlando were for purpose classified as leisure trips; another 14 % of travelers visited friends or relatives. Of those visiting Orlando for leisure purposes, 65 % chose rental car as the egress mode, whereas of those

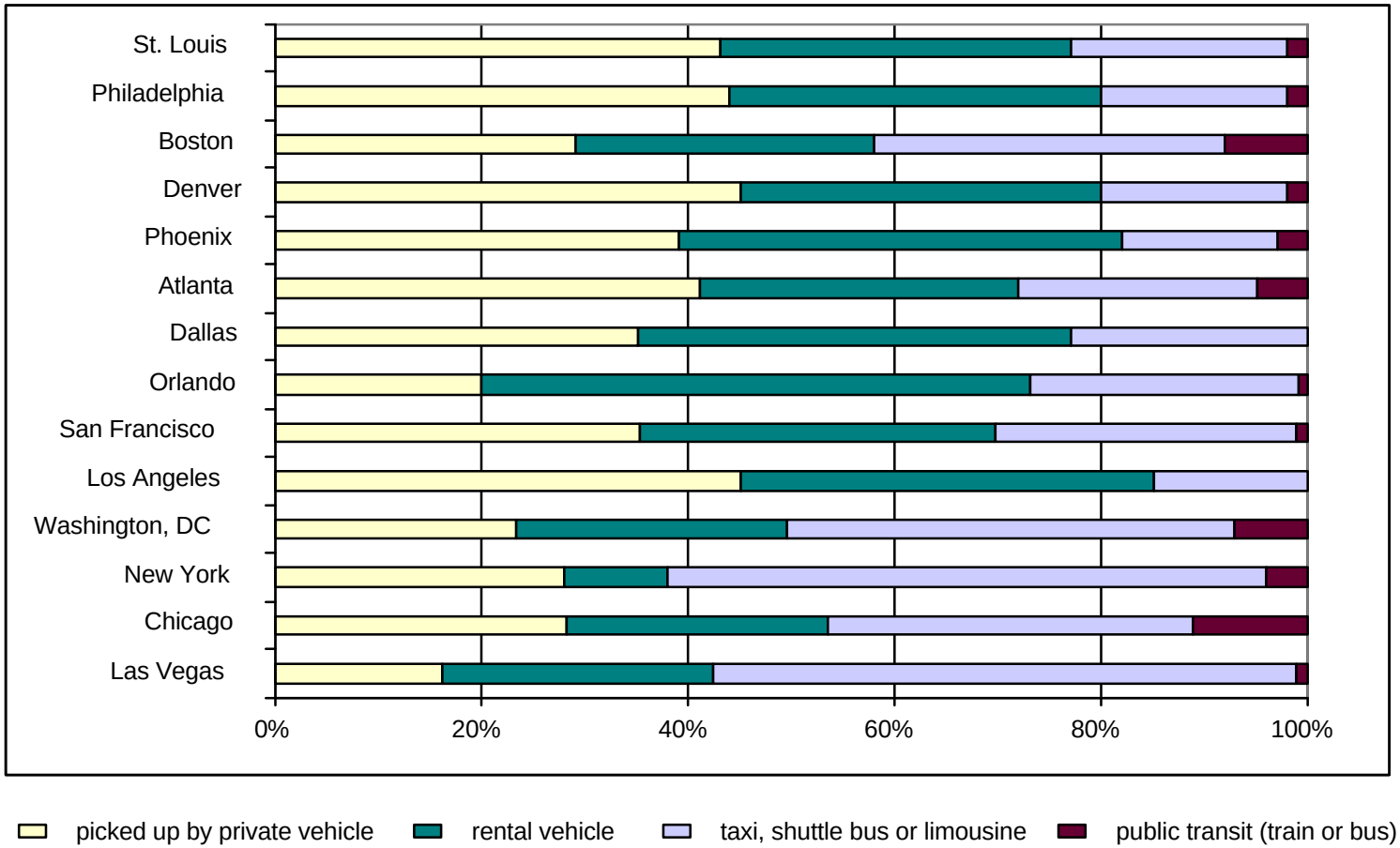

Figure 11. Egress mode used by air travelers to selected metropolitan areas (percent of person trips) (1995 American Travel Survey, U.S. Bureau of Transportation Statistics).

visiting friends and relatives 80% were picked up by private vehicle at the airport. Most whites visiting Orlando rented cars (~ 55 %); Blacks used rental cars slightly more than one third of the time (38 %); and limo/shuttle bus 30 % of the time. The dominant use of rental cars probably reflects the desire of tourist to have the flexibility of driving to the numerous, but somewhat widespread tourist attractions and amusement parks in the Orlando area.

In contrast, only 10 % of travelers to New York used rental cars as an egress mode. This probably reflects the difficulty of driving and parking in the New York area as well as the adequacy of public transit (bus and subway) in meeting the needs of most New York visitors. More than half (58 %) of the visitors to New York traveled by taxi or limo/shuttle bus to their final destination. Approximately 28 % of visitors were picked up by private vehicle; the remaining travelers used public transit to travel to their destination. Approximately half (53 %) of the visitors to New York traveled for business; 21 % visited friends or relatives; 13 % visited for leisure purpose, the remaining traveled for personal business.

Over 60 % of visitors to Las Vegas indicated they traveled for leisure reasons. Only 21 % of visitors to Las Vegas were business travelers. In contrast to Orlando (the other major tourist city examined in this study), most visitors used taxi or limo/shuttle to travel to their final destination. This may reflect the close proximity and/or integration of tourist attractions and casinos with hotels. Furthermore, many hotels offer shuttles or limo service to and from the airport.

Dallas, TX and Washington, DC had the highest percentage of business travelers, 70 and 67% respectively. In Dallas 42 % of visitors used rental cars, 35 % were picked up by private vehicle, the remainder used a taxi or limo/shuttle as an egress mode. In Washington, DC 43 % took a taxi or airport shuttle to there final destination, 7 % used public transportation, 23 % were picked up by private vehicle, and 26 % used a rental vehicle.

More than 30 % of visitors to Philadelphia, Denver, Los Angeles, and Phoenix listed visiting friends or relatives as the primary reason for their trip. In three of these cities, the dominant egress mode was being picked up by a private vehicle followed by rental cars. In Phoenix, visitors traveled by rental car 43 % of the time and were picked up by private vehicle 39 % of the time. Use of taxi or limo/shuttle in these areas was less than in many other cities. In all four of these cities, visitors used taxi, limo/shuttle or public transit 20 % of the time or less.

5. SUMMARY AND DISCUSSION

Data from the 1995 ATS demographic file suggest that the accessibility of the air transportation system may be significantly influenced by the demographic and socioeconomic status of persons and their households. In particular, household income strongly influences whether persons choose to (or are able to) travel by air. Only 10 % of people reporting household income less than $25,000 took

at least one long-distance trip by commercial air in 1995, whereas 35 % of people with household income greater than $75,000 made at least one commercial air trip.

The extent of geographic areas served by a particular airport depends upon where the airport is located, what functional class (size of facility, hub/non-hub, etc.) the airport is in, and what services (airline choices and frequencies) are available from the airport. The ATS data indicate major airports with a greater availability of service typically serve larger geographic areas. In cities served by multiple large airports, residents still tend to choose the airport nearest their home although the market areas do overlap and some travelers do travel to more distant airports. The Atlanta airport, a large geographically isolated hub in the southeastern U.S. serves a larger geographic area; approximately 10 % of passenger trips originating from Atlanta resulted from travelers from neighboring states (e.g. Alabama and Tennessee).

The ATS data indicate that more than half (54 %) of all out-bound air passengers drove to the airport and parked their vehicles at the airports. Approximately 31% of air travelers were dropped off at the airport by private vehicles. Taxi and limo or shuttle bus provided transportation to the airport for approximately 13 % of the outbound trips. In general business travelers were more likely to drive to the airport and park, whereas pleasure travelers were more likely to be dropped off at the airport. Regional differences are apparent in the mode used to access the airport. With the exception of travelers departing from the three airports serving the New York area, most business travelers drove to the airport and parked. Business travelers from Newark, John F. Kennedy, and La Guardia were more likely to take a taxi, shuttle bus or limousine. Public transit was not the dominant access mode for any of the airports, but travelers from Atlanta, Washington National, and Boston's Logan airport used public transit more frequently.

The ATS data also indicate that the majority of travelers were either picked up by private vehicle (36 %) or used a rental car (36 %) to get from the airport to their final destination. Approximately one quarter of the travelers used taxi or shuttle bus to reach their final destination. Only a small percentage (approximately 2 %) used public transportation (bus or rail) to travel to their final destination. The egress mode appears to vary significantly from city to city (Figure 11). For example, in Las Vegas and New York greater than 50 % of travelers took a taxi or airport limo/shuttle to travel to their final destination, whereas overall only 25 % used this mode. Public transit was not the dominant egress mode for any of the MSA's, but it was higher (ranging from 5% to 11%) in four cities (Chicago, DC, Boston, and Atlanta). All of these cities offer rail transportation to and from the airport. Public transportation was utilized as an egress mode for less than 5% of person-trips in the other ten cities. More than half (54 %) of travelers to Orlando, primarily a tourist destination, used a rental car to reach their final destination.

There is much work left to be done in this study of airport accessibility. In particular, future work should include comparison of the ATS air travel data with other available air travel statistics. For example, the Office of Airline Information includes detailed information regarding the number of scheduled (and unscheduled) flights, number of major airlines serving a particular airport, as well as the destination cities served by these airlines for major U.S. airports. This data could be used in

conjunction with the ATS data to further investigate what non-pricing factors affect travelers choice of airport.

6. REFERENCE

American Public Transit Association. (1996). *1996 Transit Fact Book*.

Cohas, F.J., P. P. Belobaba, and R. W. Simpson. (1995). "Competitive Fare and Frequency Effects in Airport Market Share Modeling," *Journal of Air Transport Management,* Vol. 2, No. 1., pp 33–45.

de Neufville, R. (1995). "Management of Multi-Airport Systems, A Development Strategy," *Journal of Air Transport Management,* Vol. 2, No. 2., pp 99–110.

Harvey, G. (1987). "Airport Choice in A Multiple Airport Region," *Transportation Research* 21A (6) pp 439-449.

Newmark, G. (1999). "Rail's Share of Airport Access: Examining the Data," paper presentation at the *78th Annual Transportation Research Board Meeting,* 1999.

U.S. Department of Transportation, Bureau of Transportation Statistics. (1996). *Airport Activity Statistics of Certificated Air Carriers,* Office of Airline Information.

U.S. Department of Transportation, Bureau of Transportation Statistics. (1999). *1995 American Travel Survey—Household and Person Demographic Files*, CD-ROM,